

Characteristics and Ecological Impacts of Atmospheric Deposition in Urban and Urban-Affected Regions

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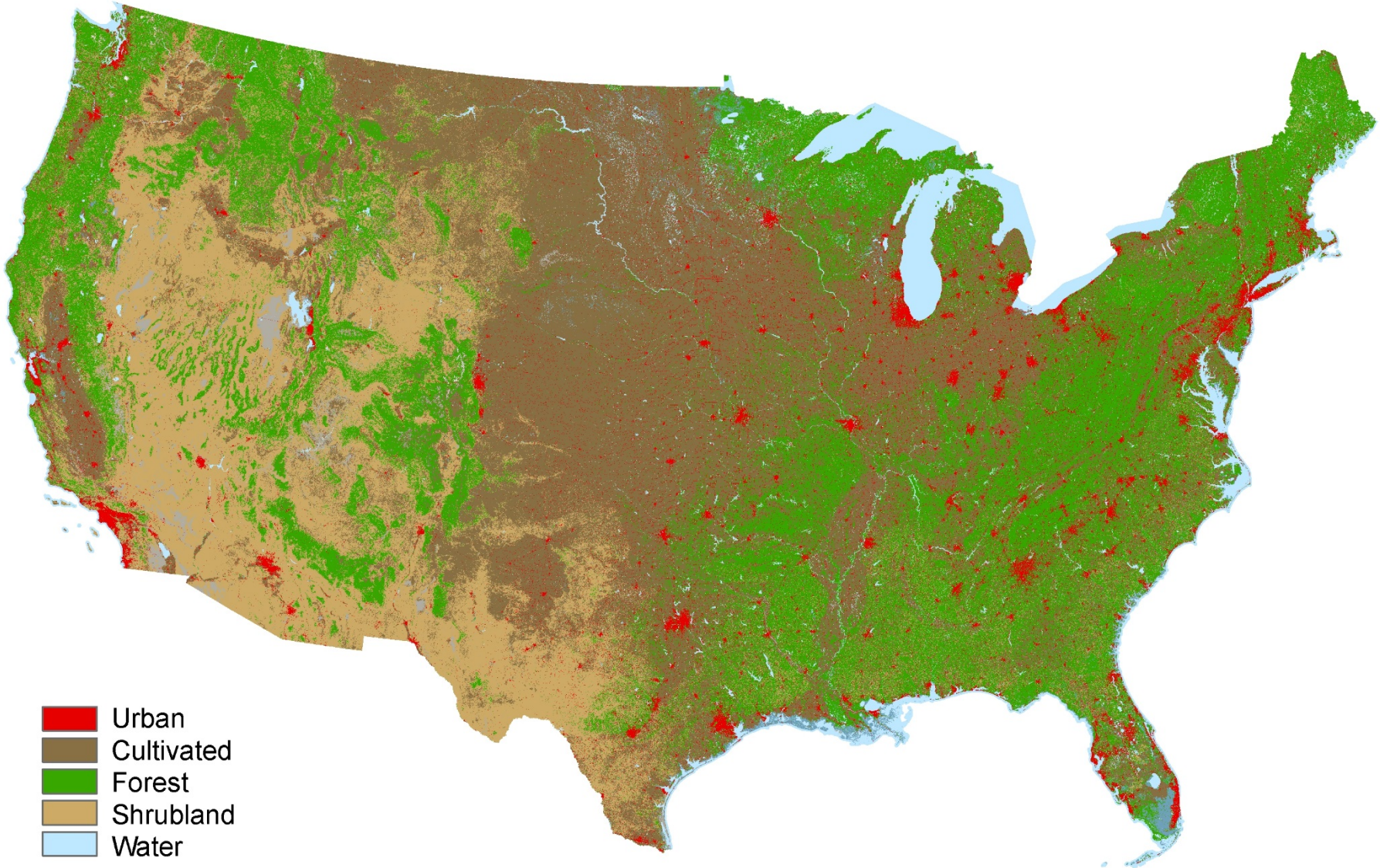
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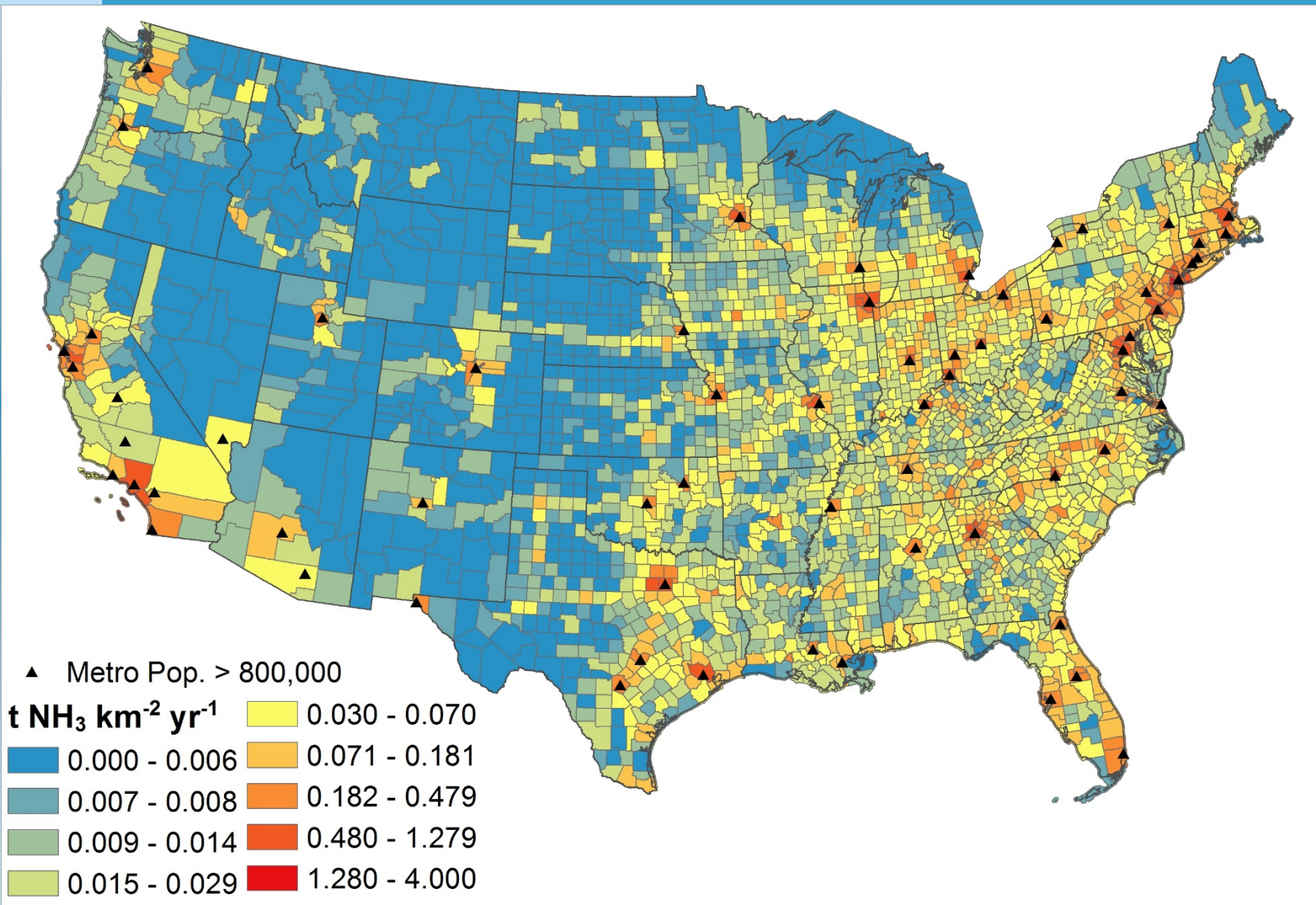


PSW Res. Stn.

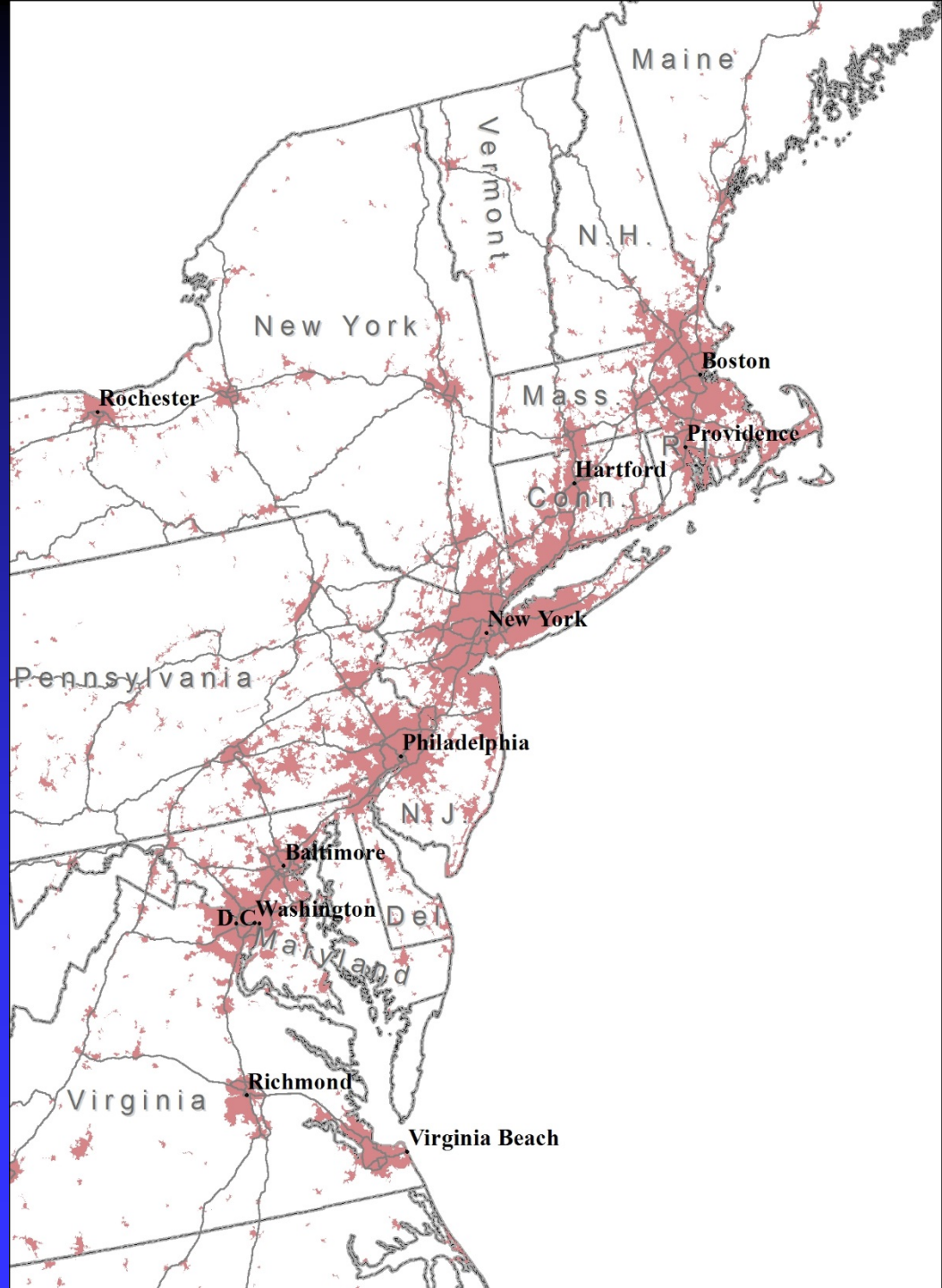
Land Cover Mosaic: How extensive is the footprint of ecological effects from urban emissions?



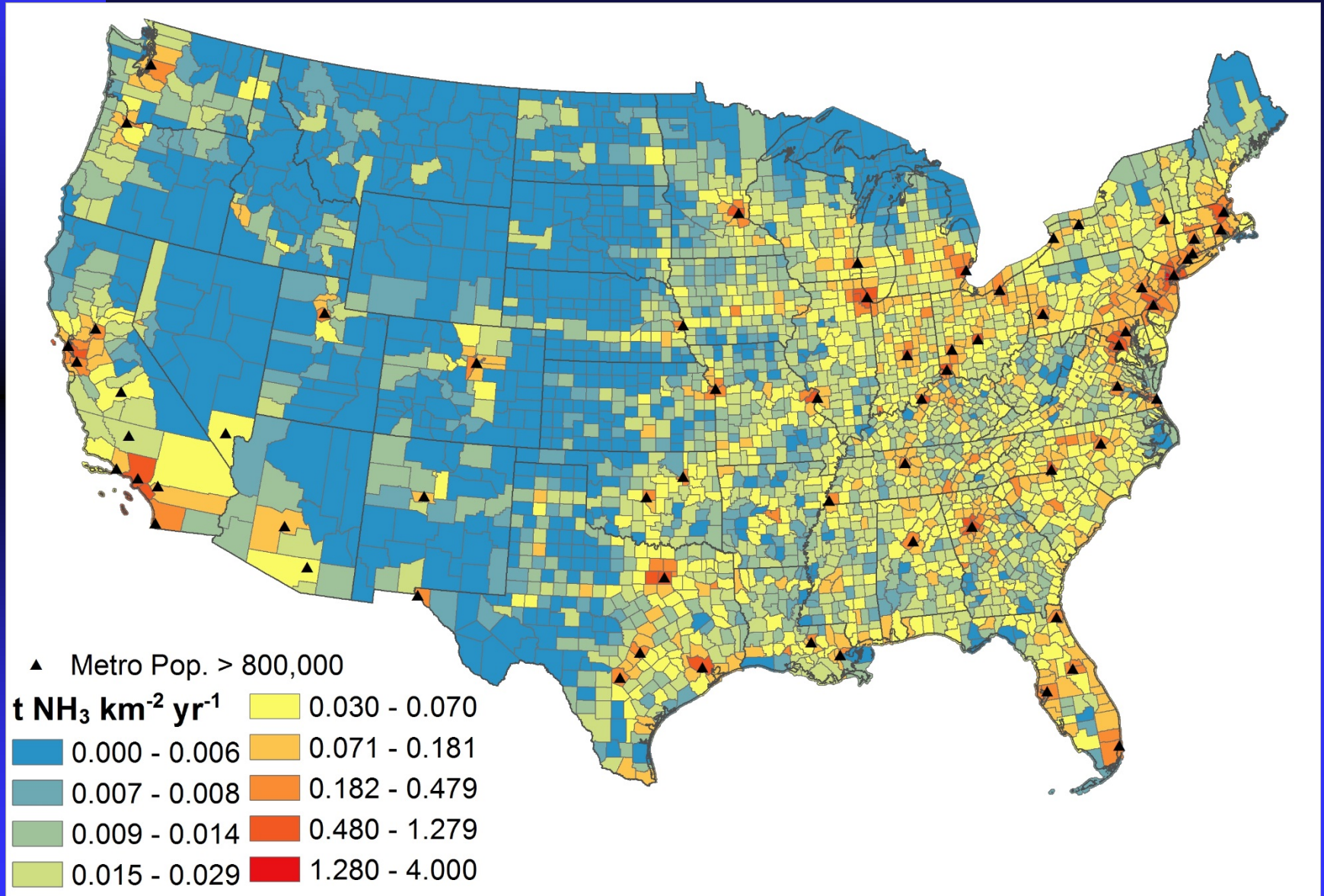
On-Road Emissions of NH₃ by County



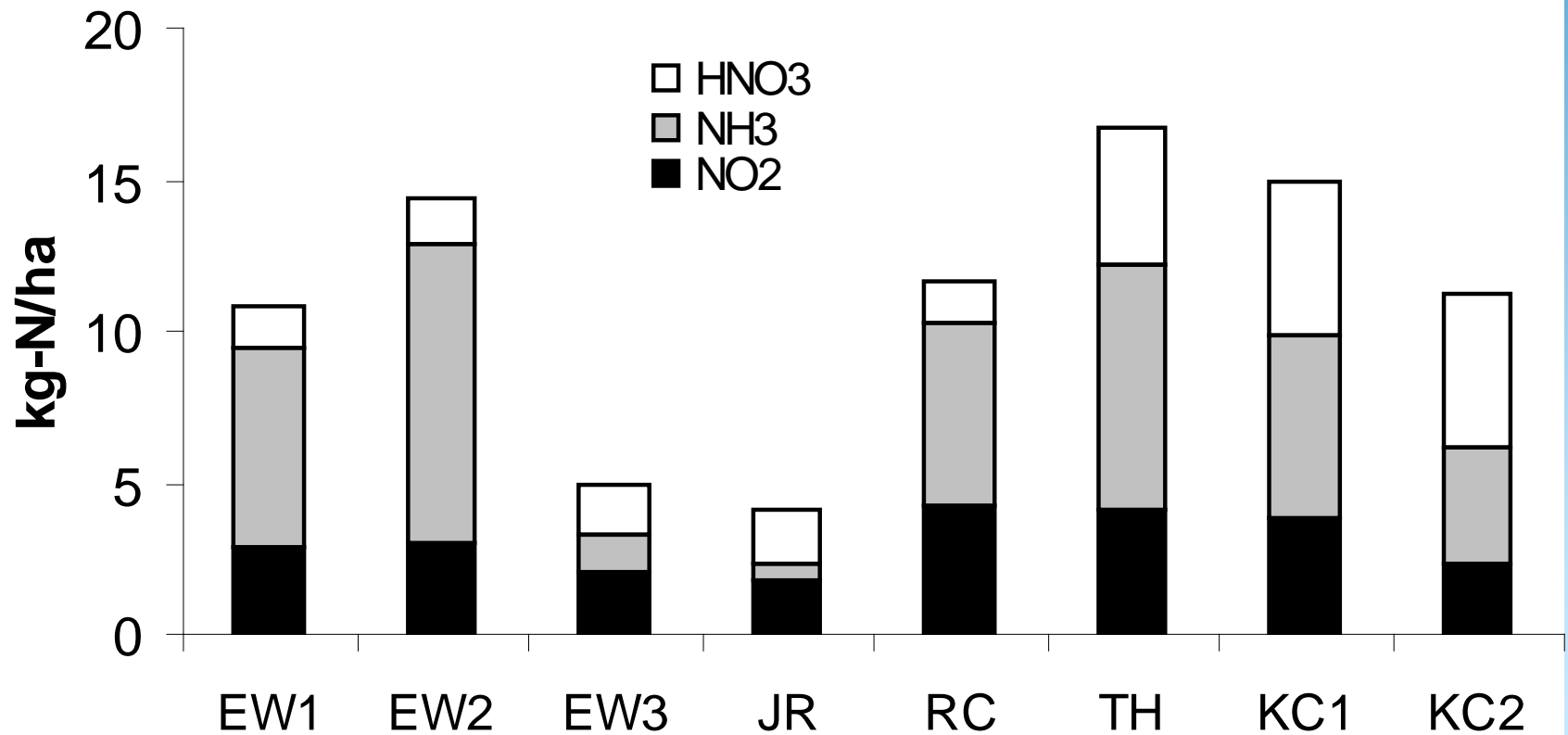
Urban corridor from DC to Boston



On-Road Emissions of NH_3 by County



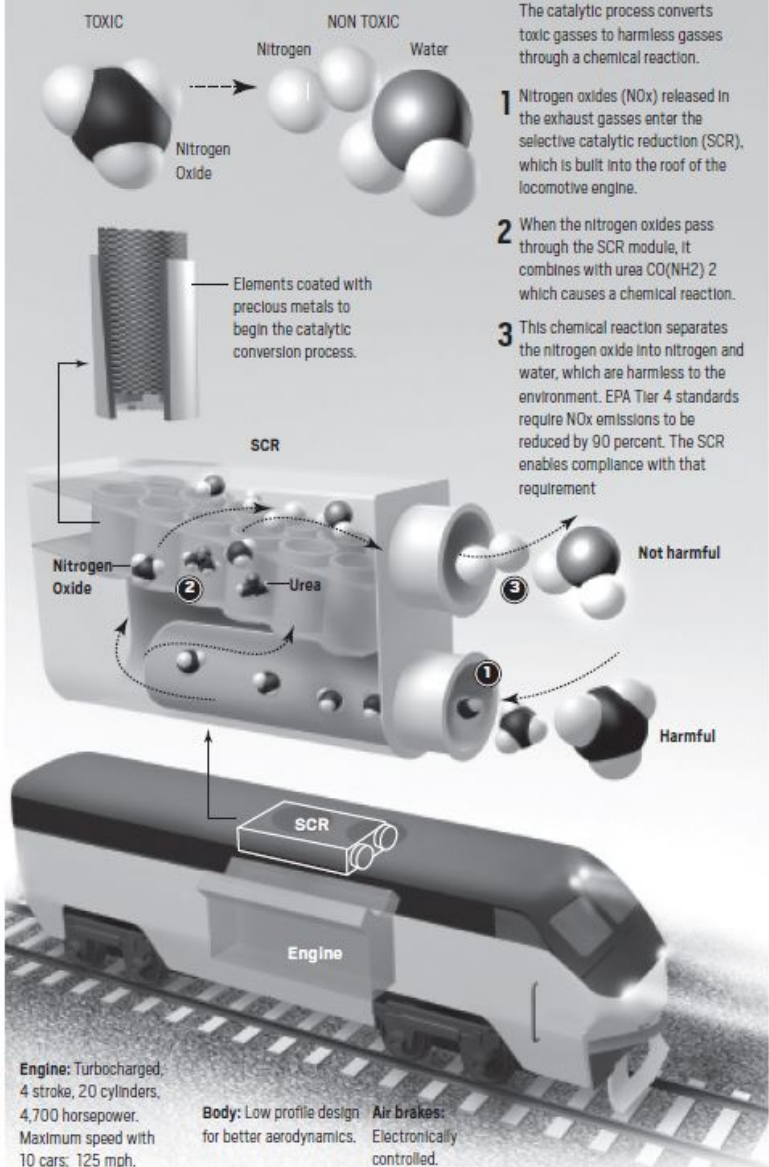
N gaseous pollutant deposition to a California grassland near a major highway (280) in the coastal San Francisco peninsula and in near-urban sites



A recent example of the trend of increasing NH_3 production by additional types of vehicles and engines.

BURNING CLEANER DIESEL

The new F125 is designed to be the cleanest-running passenger locomotive in the United States and the first in regular service to meet strict environmental standards that will become mandatory in 2015. By using a similar catalytic-converter technology also used on newer highway trucks with added reductant (urea), Electro-Motive expects the new engines to reduce particulate-matter pollution by 90 percent and nitrogen-oxide emissions by 80 percent.



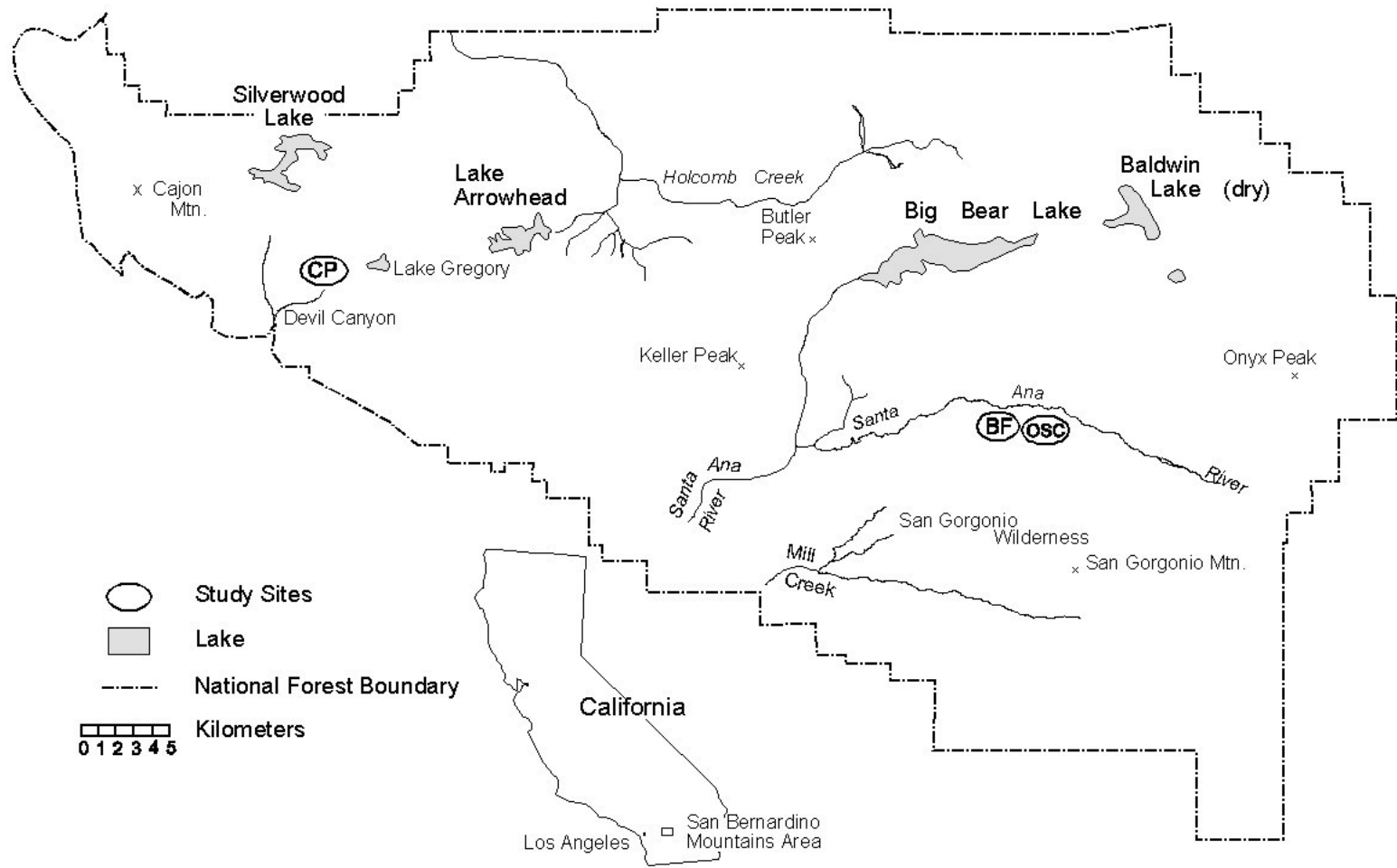
The catalytic process converts toxic gases to harmless gases through a chemical reaction.

- 1 Nitrogen oxides (NO_x) released in the exhaust gases enter the selective catalytic reduction (SCR), which is built into the roof of the locomotive engine.
- 2 When the nitrogen oxides pass through the SCR module, it combines with urea $\text{CO}(\text{NH}_2)_2$ which causes a chemical reaction.
- 3 This chemical reaction separates the nitrogen oxide into nitrogen and water, which are harmless to the environment. EPA Tier 4 standards require NO_x emissions to be reduced by 90 percent. The SCR enables compliance with that requirement.

General Rule:

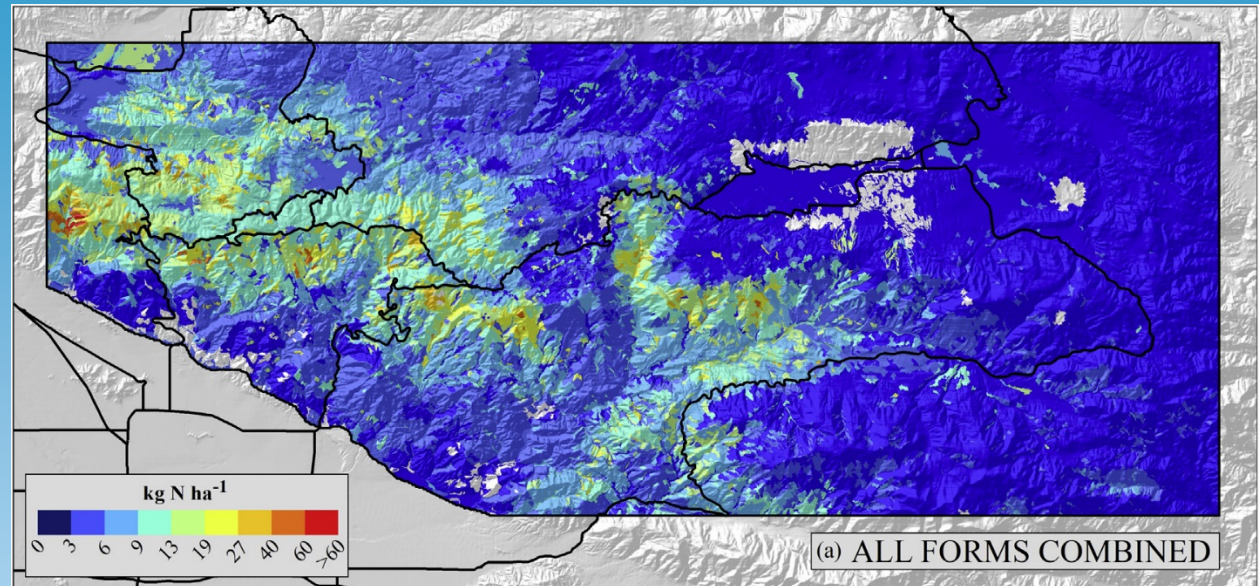
Conditions and emissions control mechanisms that result in highly effective NO_x reduction result in greater NH_3 production and emissions

San Bernardino Mountains Air Pollution Gradient

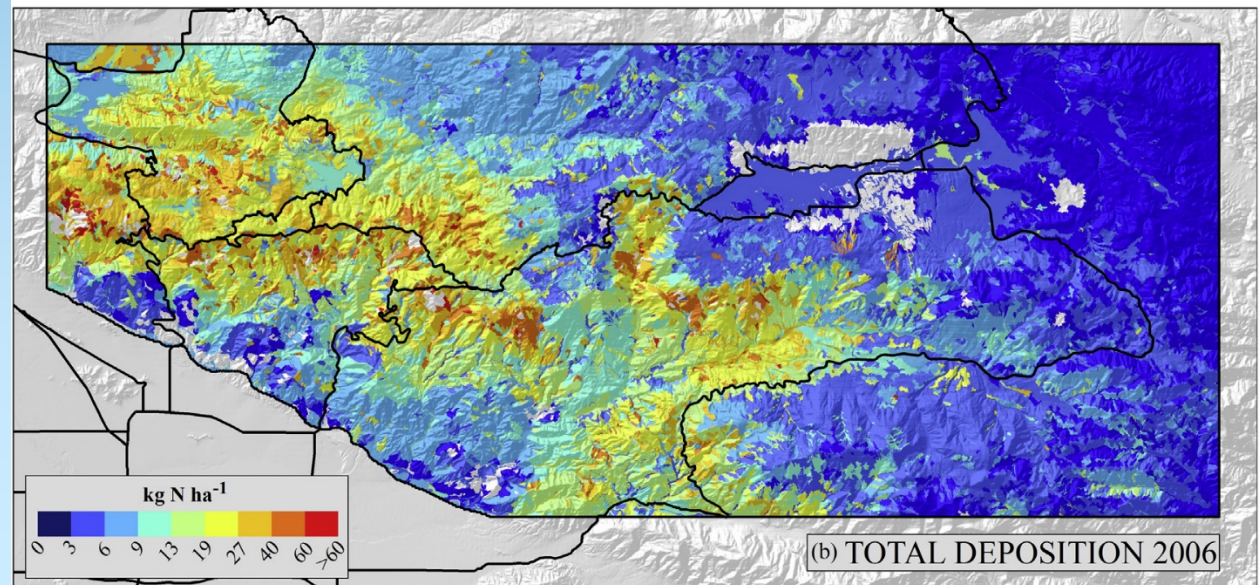


Steep N Deposition Gradient in San Bernardino Mts. in Southern California

Summer dry deposition



Annual total N deposition



Ion exchange resin throughfall collector

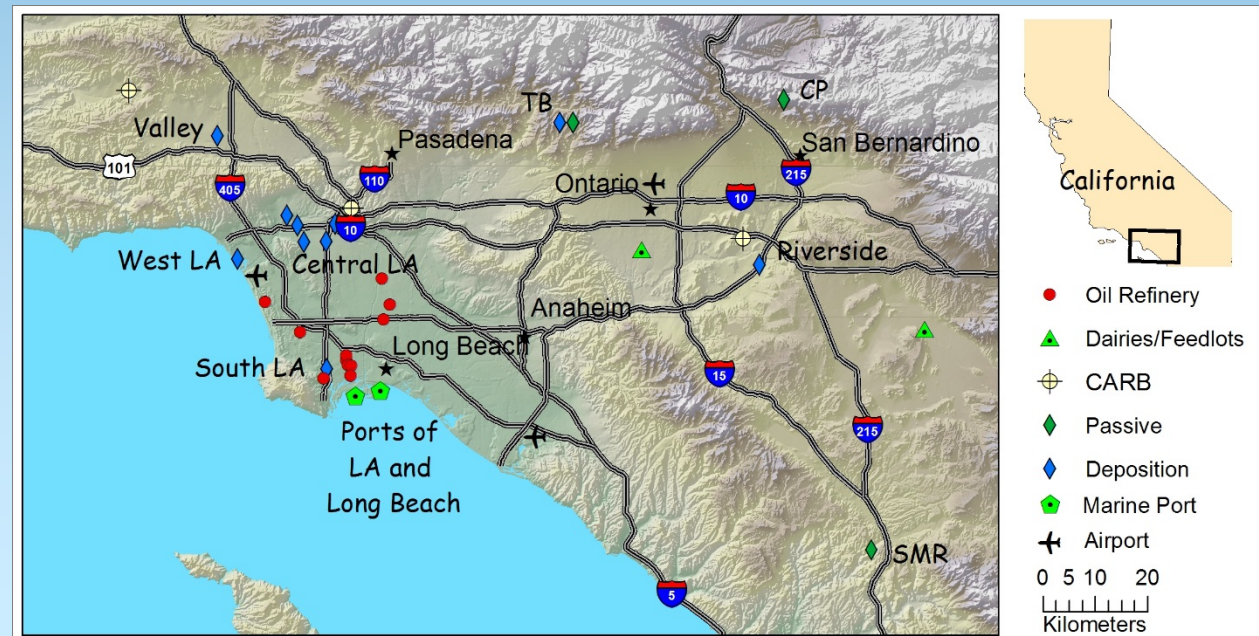
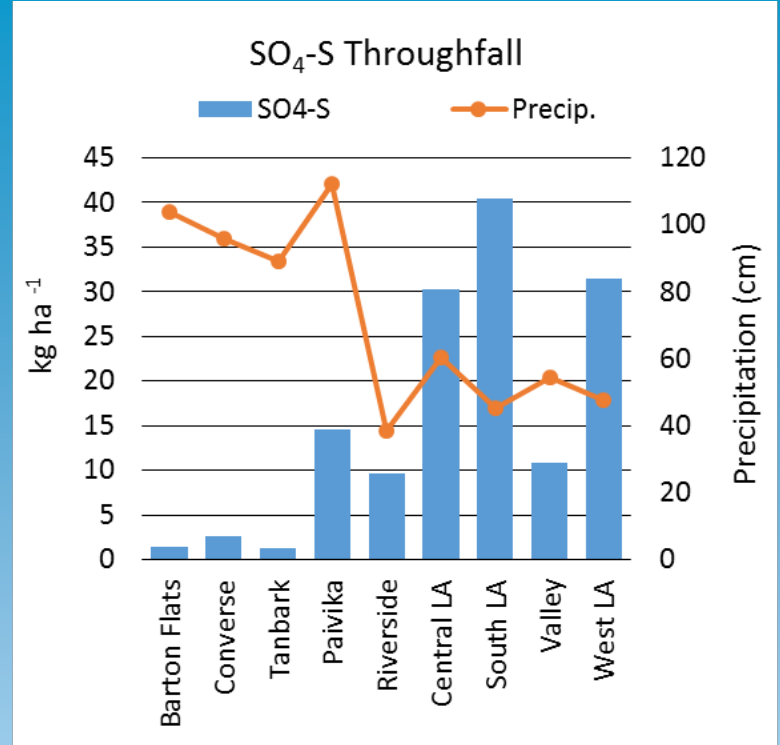




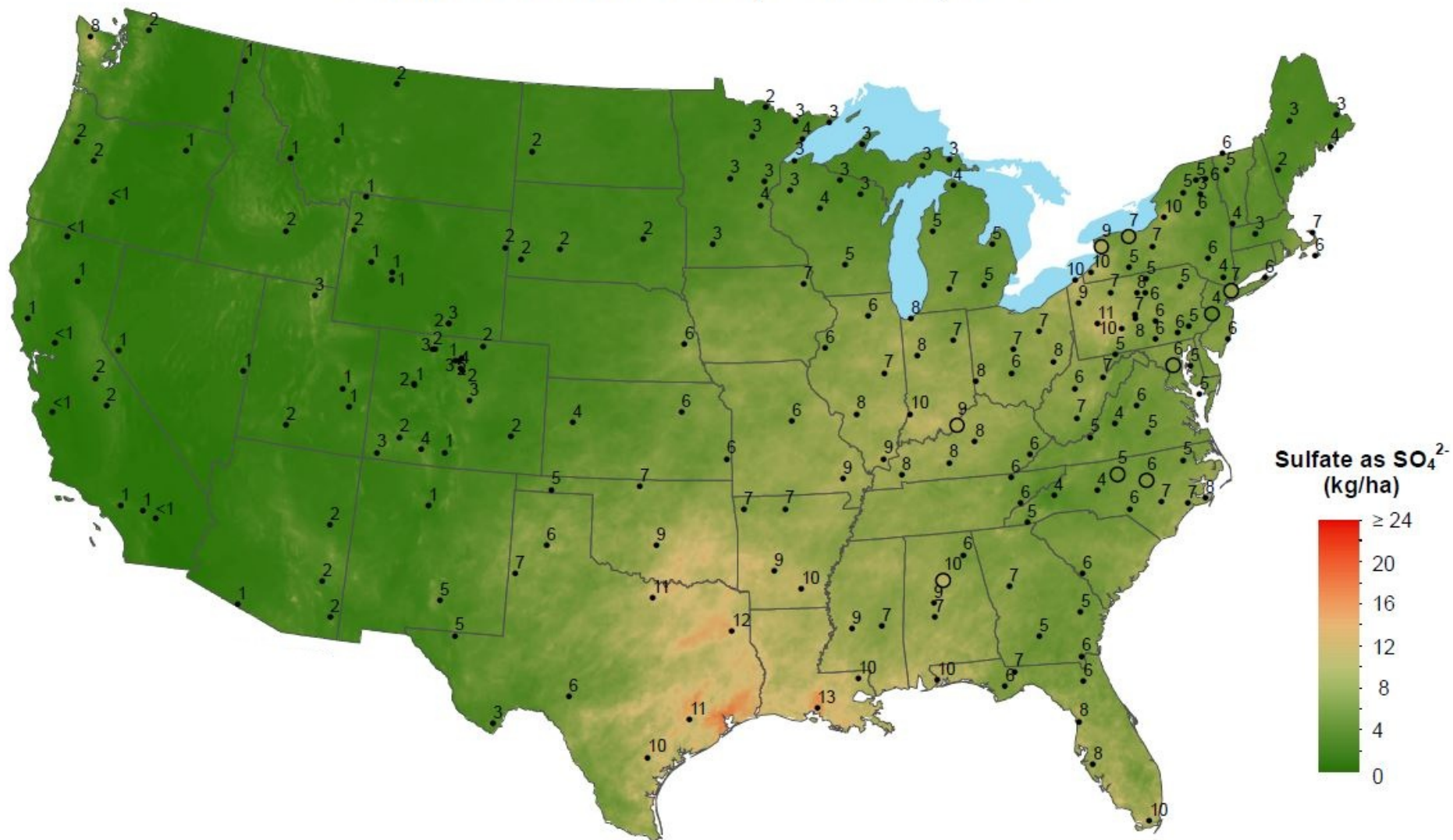
**Method we also used for
urban throughfall
deposition monitoring**

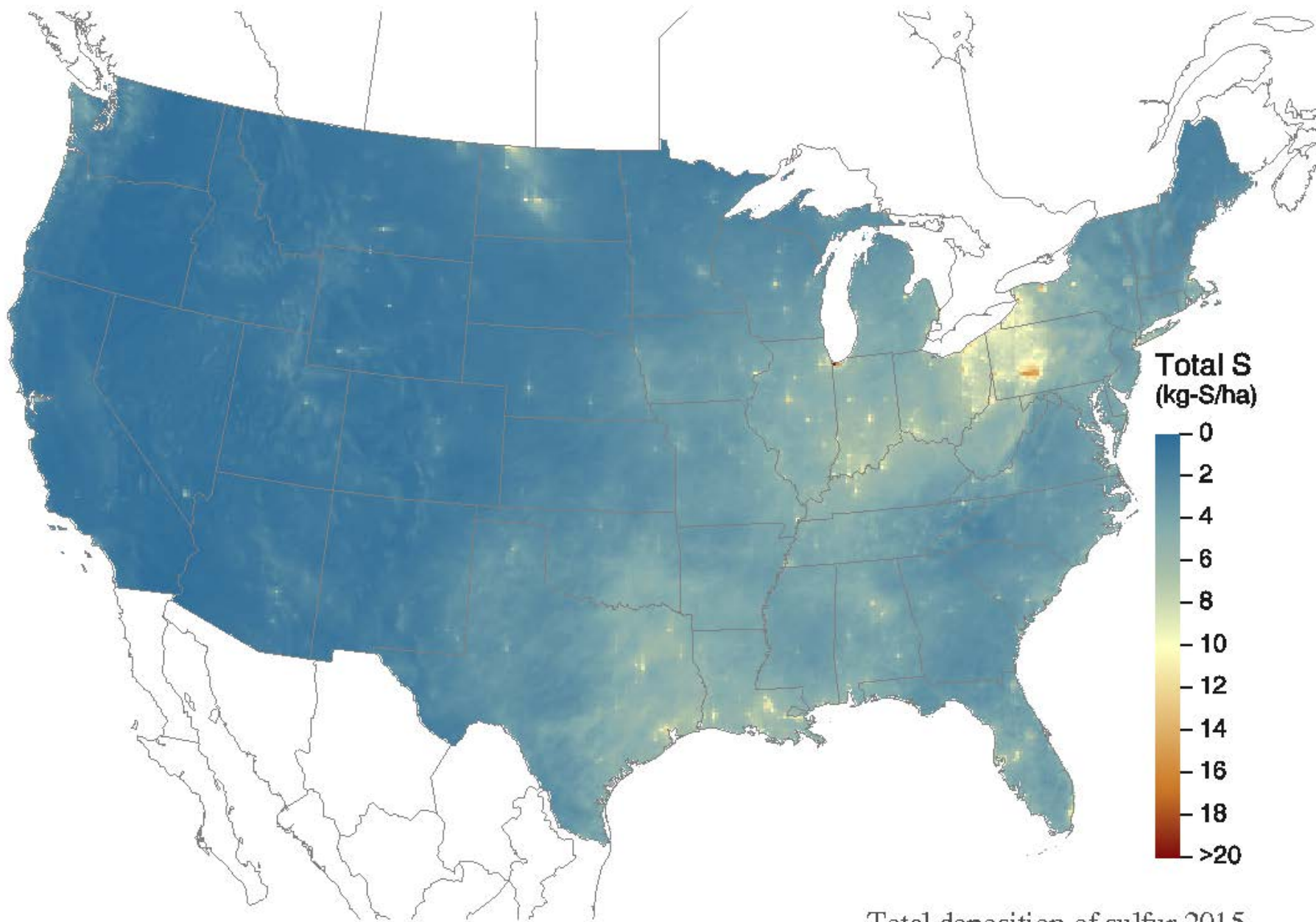


Sulfur Deposition in Urban and Montane sites in the Los Angeles Air Basin



Sulfate ion wet deposition, 2015



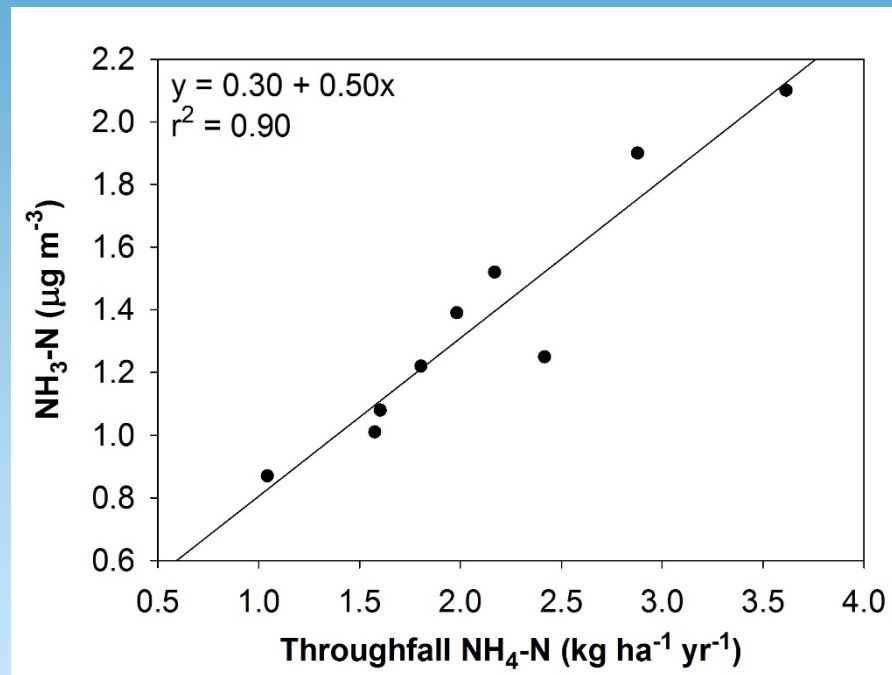
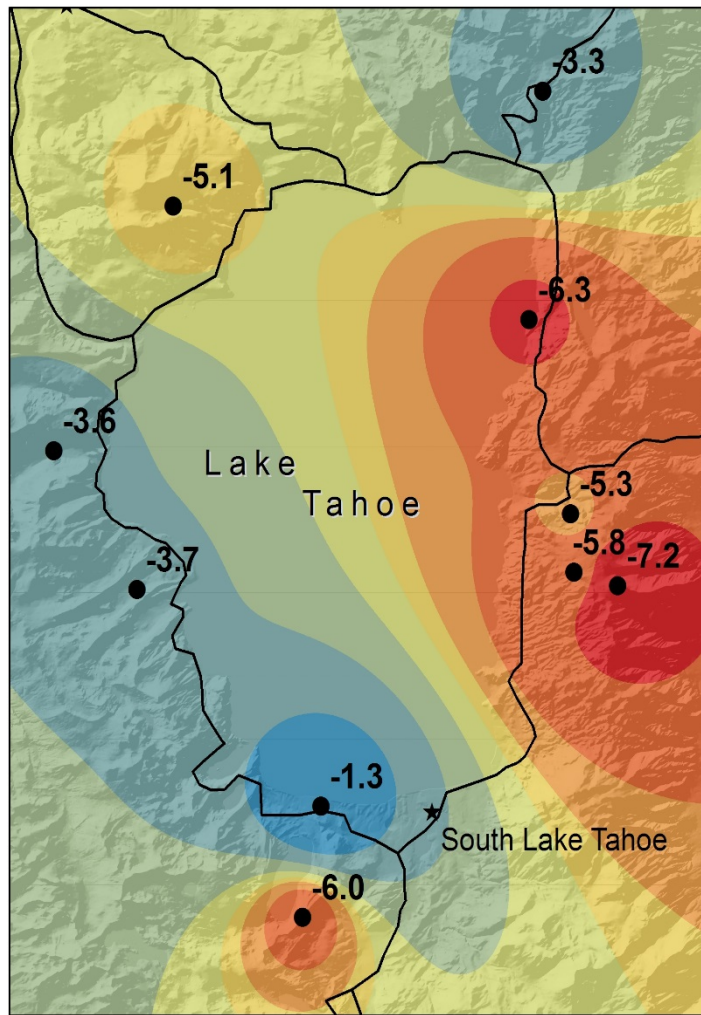


Total deposition of sulfur 2015

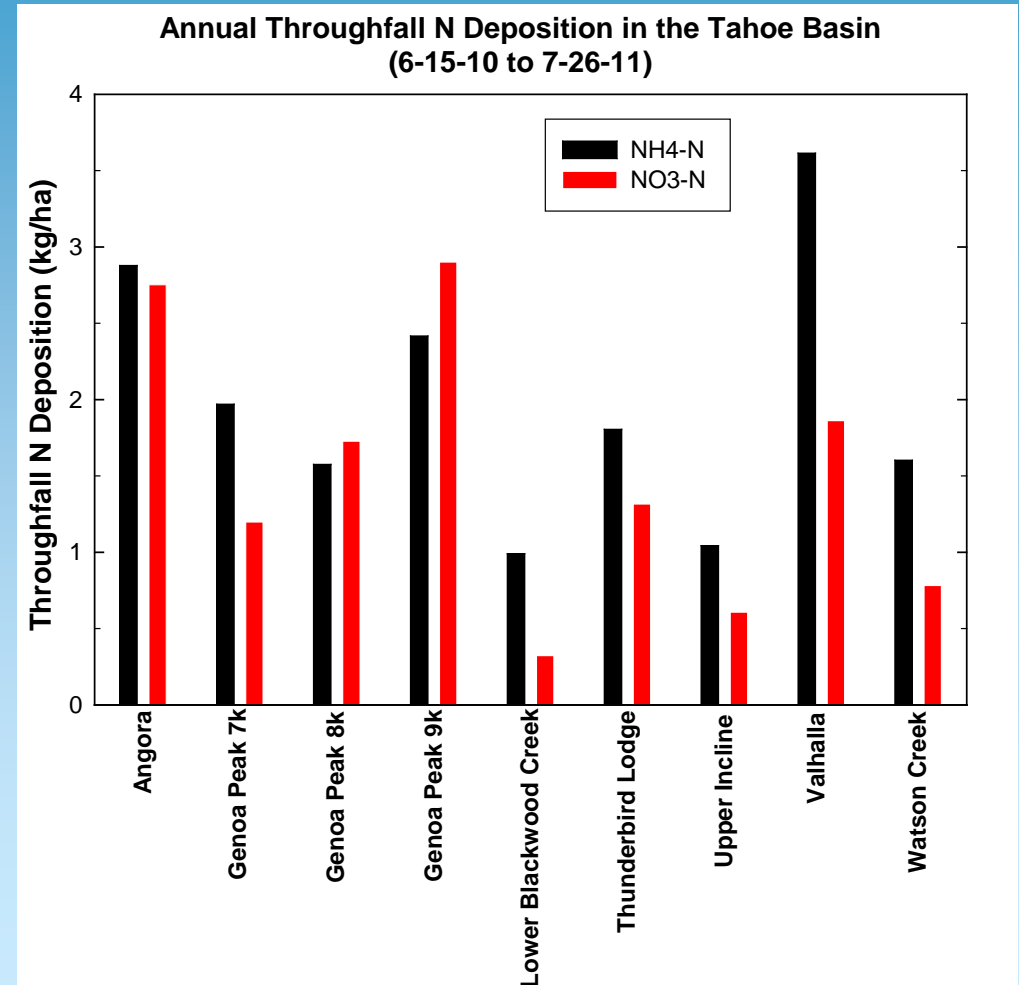
Lake Tahoe Basin---Affected by in-basin urban and on-road N emissions



Lake Tahoe Air Basin: Importance of Tailpipe NH₃ Emissions



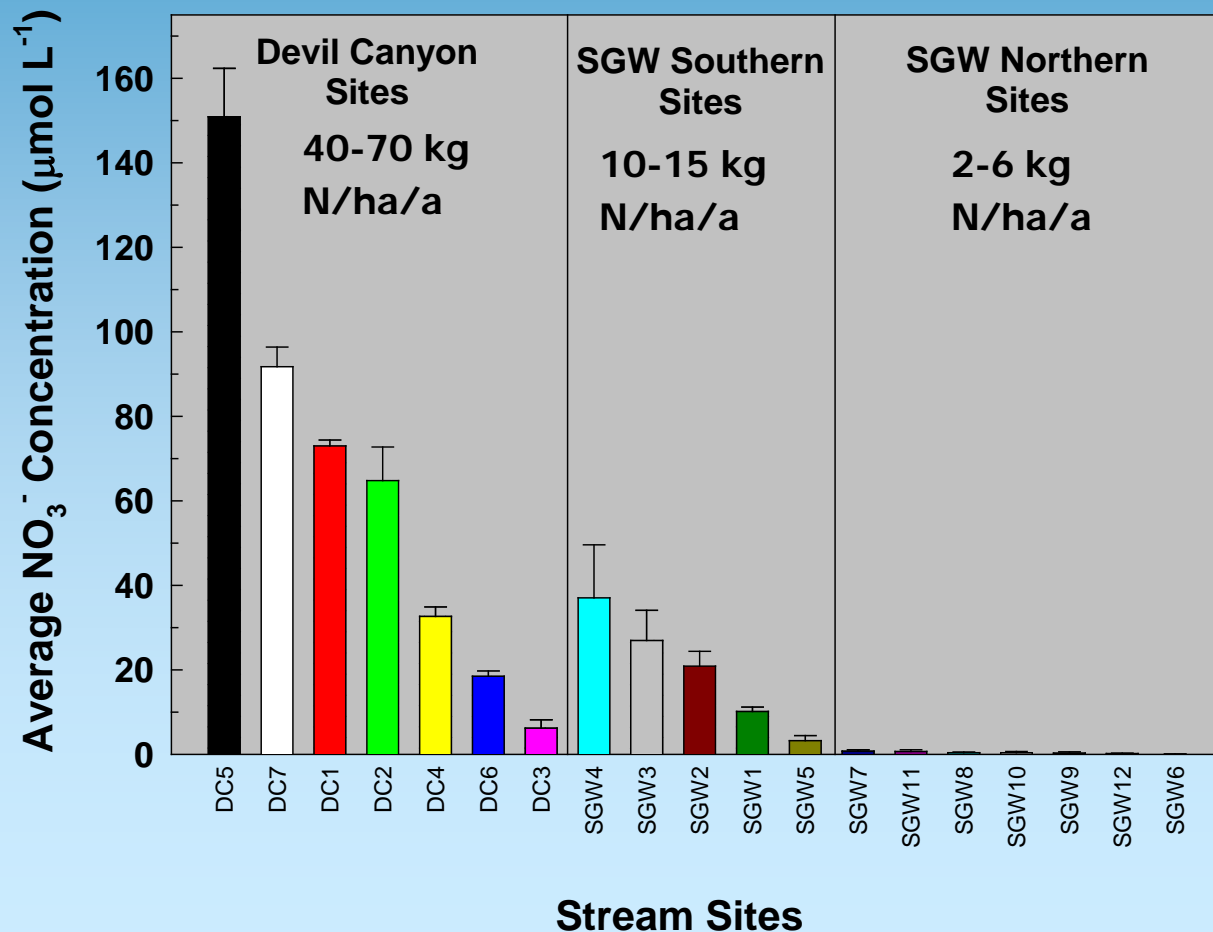
Lake Tahoe: Throughfall Deposition of N



Another General Rule:

N as a nutrient or eutrophication effects are predominant in urban-affected regions, although acidification effects also occur---depending on soil and site conditions.

Streamwater NO_3^- concentrations across a deposition gradient in the San Bdo. NF, downwind of greater Los Angeles



SMOG IN OUR WATER

What goes up, comes down

Chemicals falling from Southern California air are finding their way into drinking water. Here's how it happens:

Cars, trucks, buses and factories spew about 1,300 tons of nitrogen oxide into the air daily over Southern California.

In the foothills, each acre is blanketed by 21 pounds of nitrogen-based compounds annually in smoggy spots like San Dimas and Upland – 10 times more than in low-smog places.

Rain carries the chemicals off brushy slopes, mostly in the form of nitrate, at the rate of about three pounds per acre annually. Tainted runoff drains into streams, reaching concentrations that in some instances exceed drinking water safety standards.

The contaminant poses a threat to underground drinking water supplies because mountain watersheds are often tapped to replenish aquifers. Scientists are unsure how significant the threat is.

Source: U.S. Department of Agriculture, California Water Resources Control Board.

“We drink what we drive.”

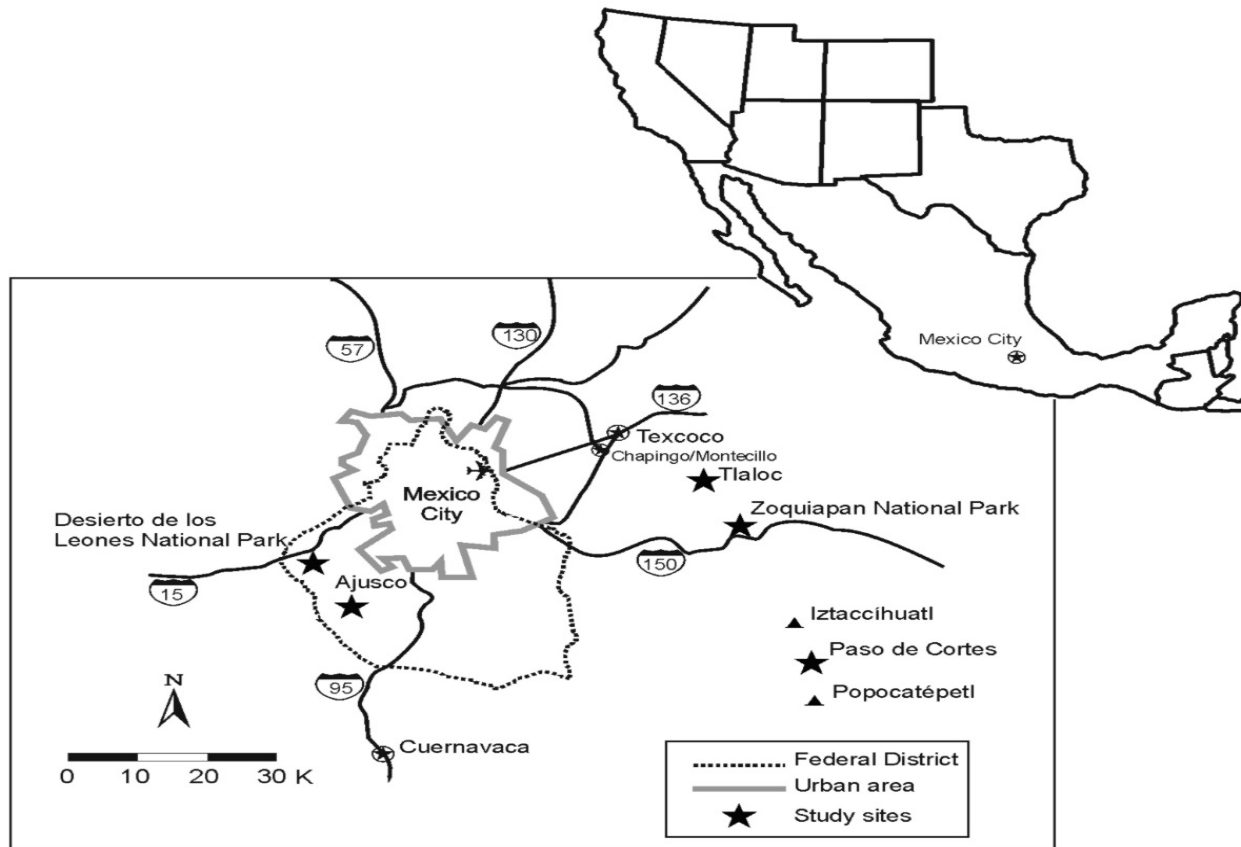
Major Air Pollution Impacts to CA Ecosystems Affected by Urban Emissions



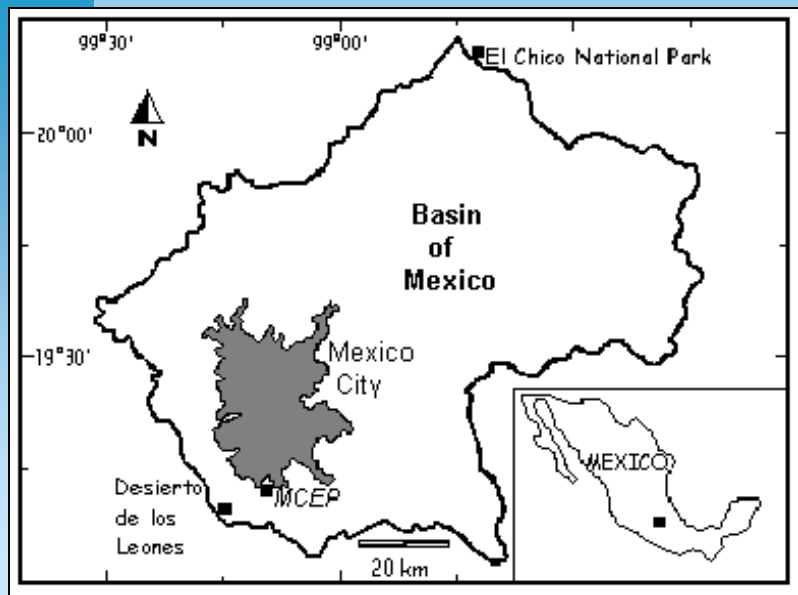
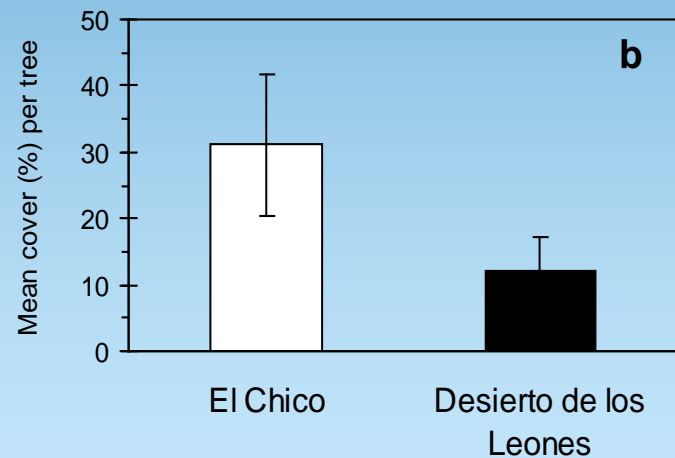
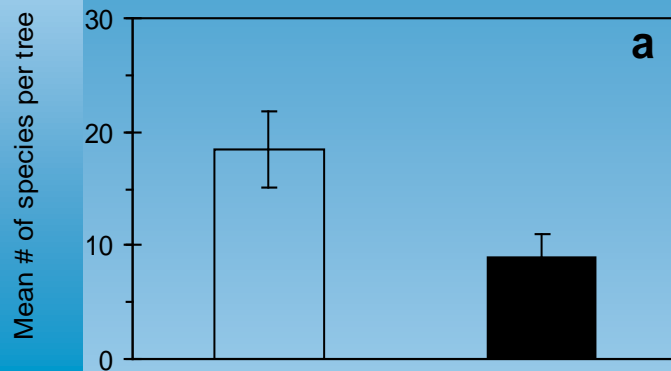
- **Forests: ozone & N co-occur; increased mortality, perturbed C & N cycling; N losses from the system, altered communities of epiphytic lichens, understory herbaceous species and mycorrhizal fungi; decreased C allocation below ground; increased fuel accumulation, stand densification and fire risk**
- **Chaparral and oak woodlands: Elevated NO_3 in runoff; altered lichen communities**
- **Desert scrub and pinyon-juniper: N deposition favors weedy invasives, increasing fire risk and vegetation type change**
- **Grassland: Community shift; loss of native species**
- **Coastal sage scrub: Altered mycorrhizal communities, plant community shifts, increase in invasive annual grasses**



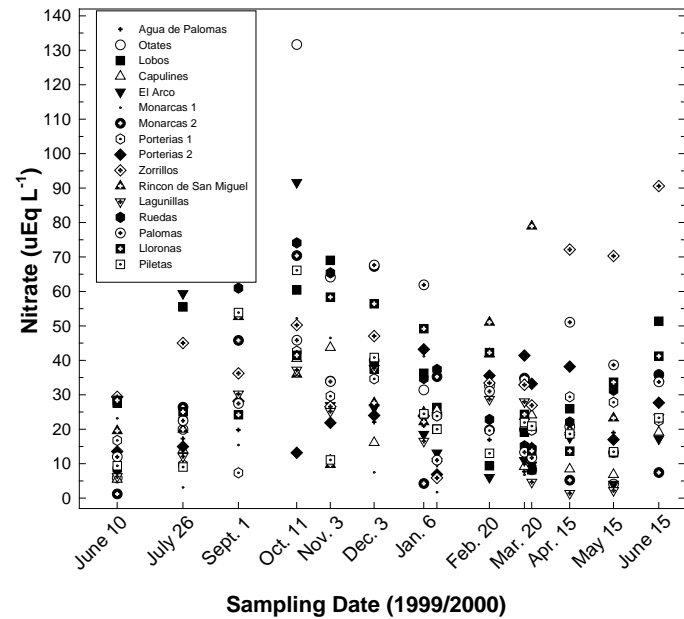
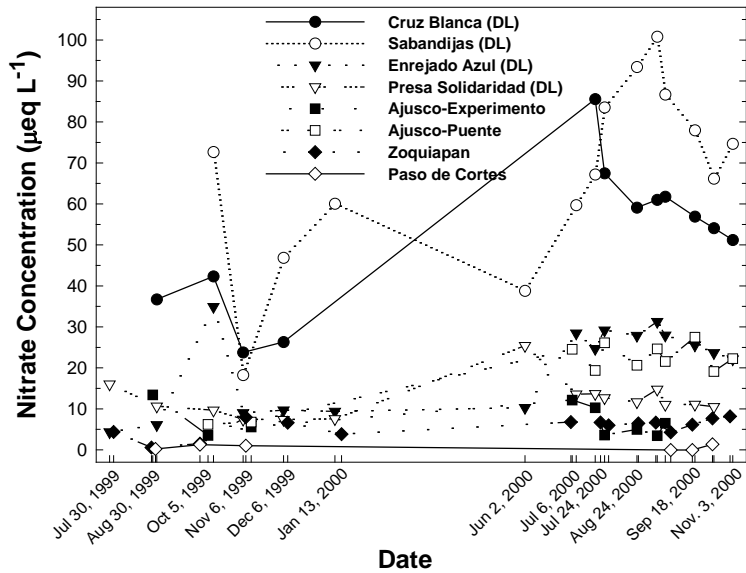
Mexico City Air Basin: Nitrogen and ozone impacted forests



Effects of Atmospheric Deposition on Lichen Communities in Mexico City



Nitrogen saturated catchments in forests downwind of Mexico City



Decline of Sacred Fir (*Abies religiosa*) in the Desierto de los Leones NP

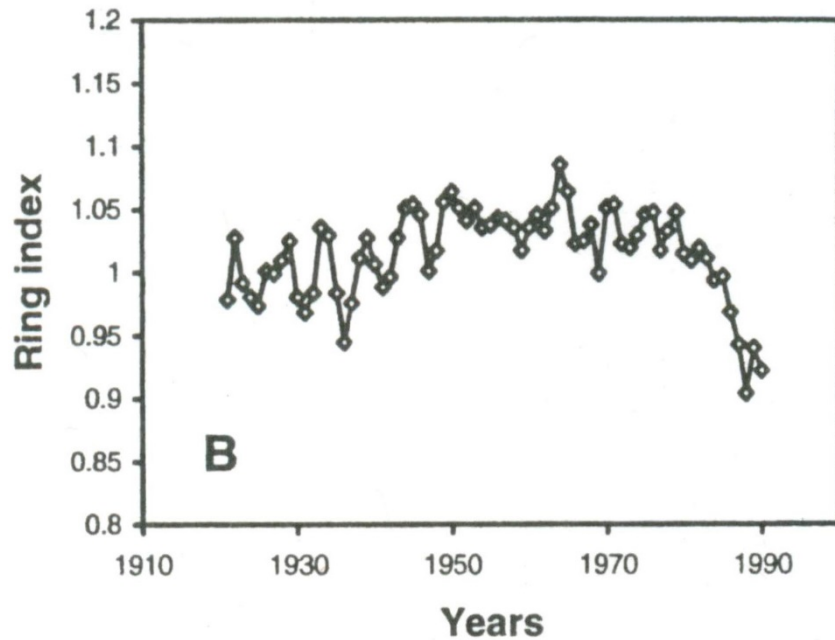


Ozone injury to *Pinus hartwegii* in the Mexico City Air Basin

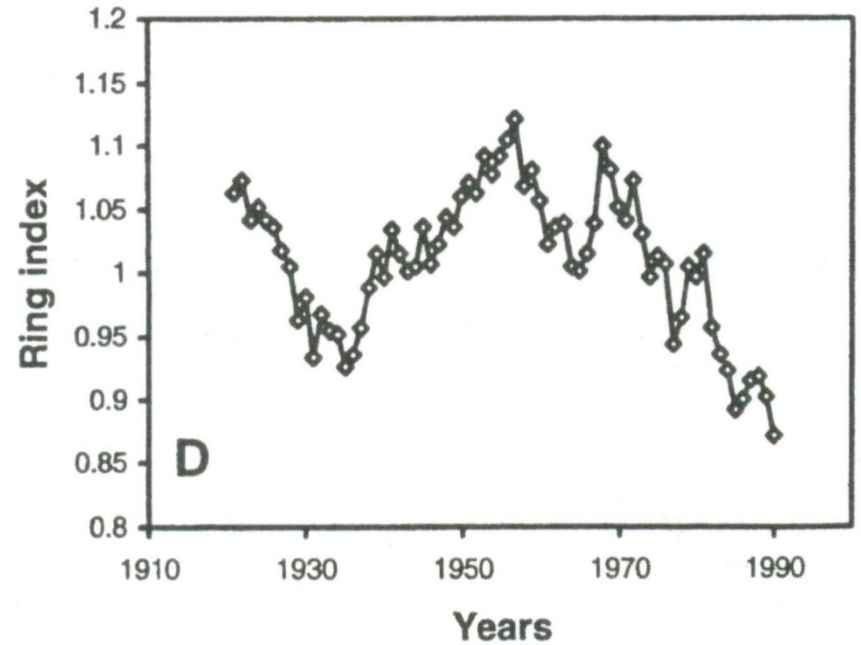


Pinus hartwegii growth decline

El Ajusco

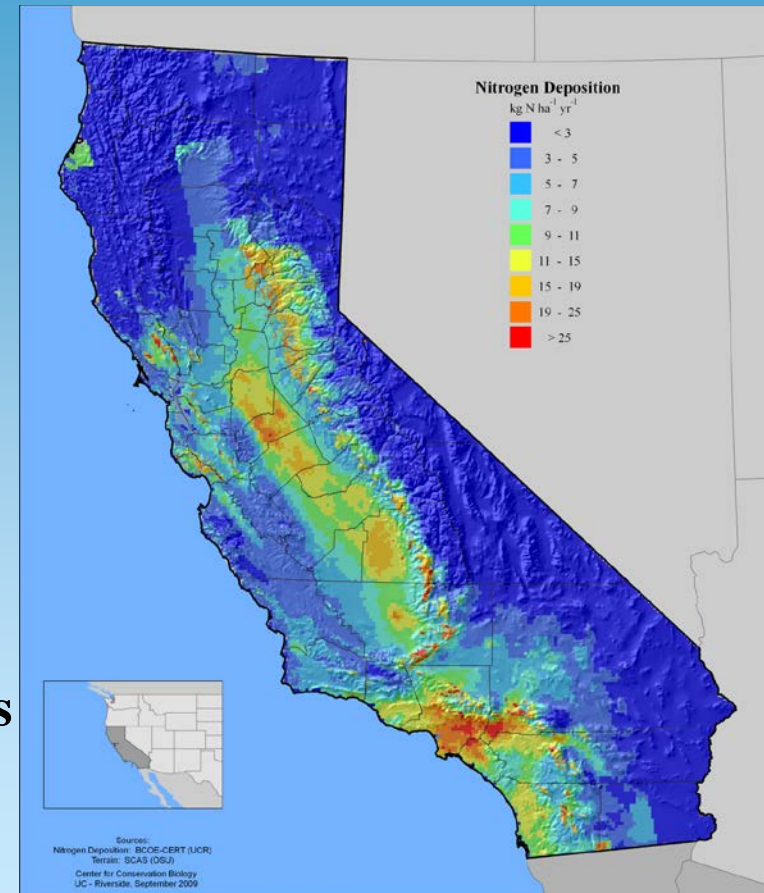


Desierto de los Leones



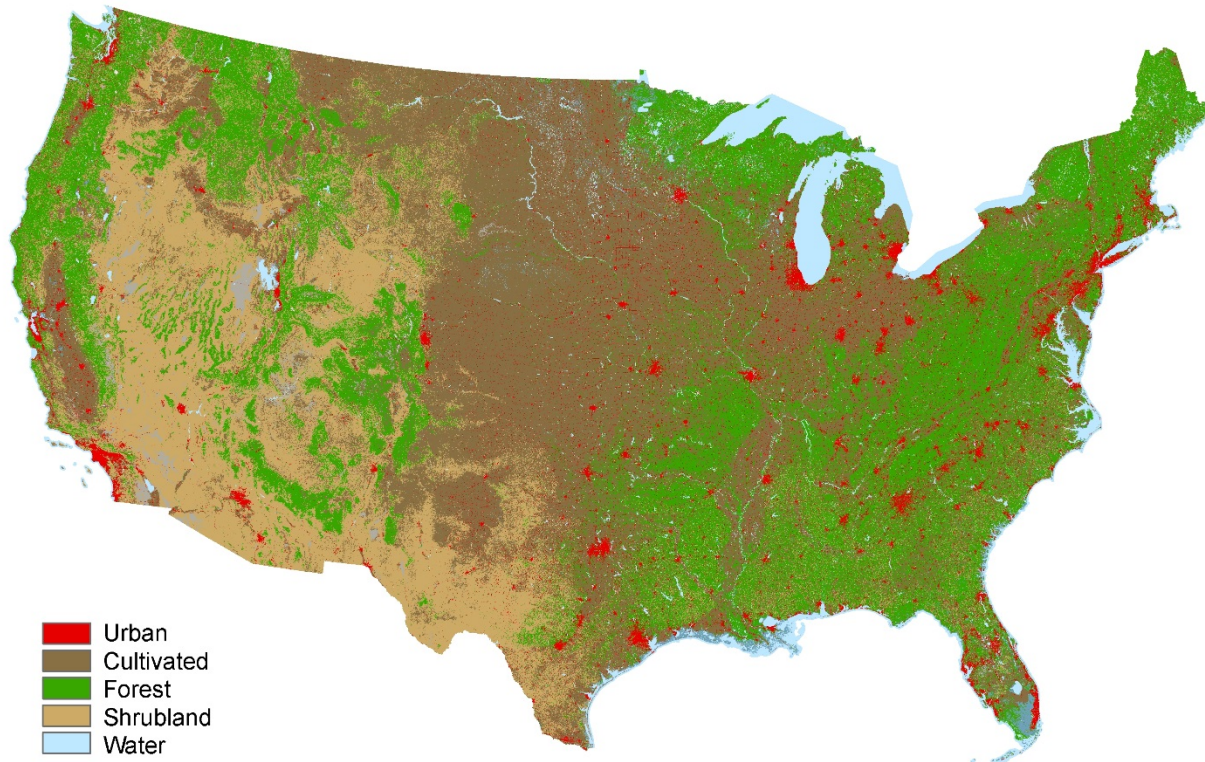
Key Points

- Many ecosystems are affected by urban emissions
- Questions remain in regard to the spatial footprint of those emissions; i.e, long-range transport of particulate N? Elevated ozone in downwind ecosystems
- Urban emissions can lead to elevated N deposition, but with steeply declining deposition with distance from the source area
- This is largely due to high deposition velocity of HNO_3 and NH_3
- Such fine scale variation in deposition fluxes are not observed in large-scale monitoring networks or simulation models

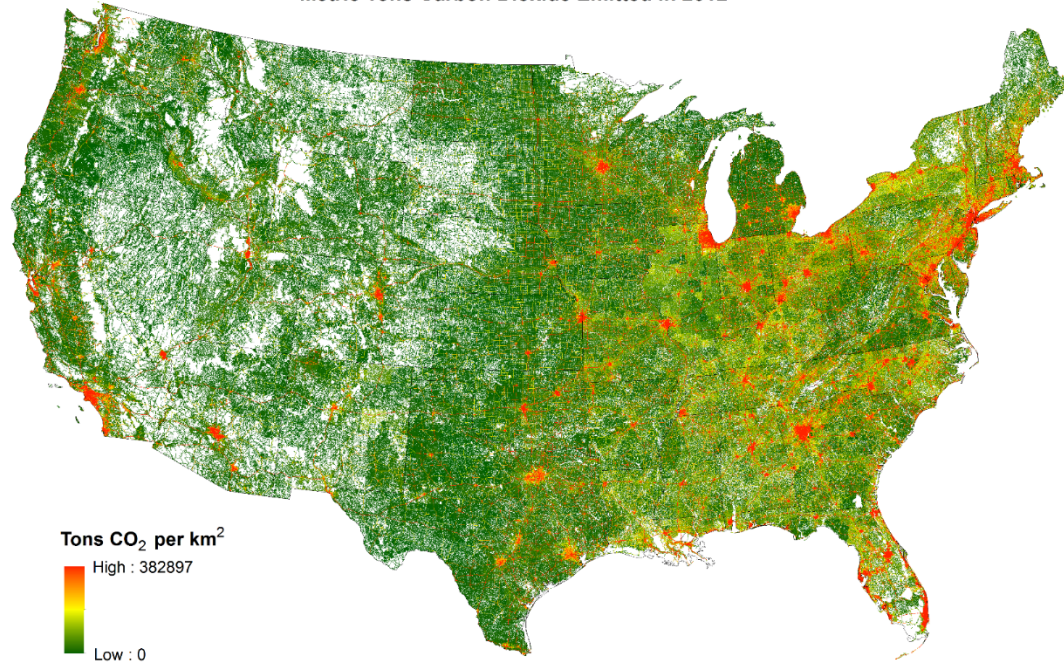


Key Points

- Land use and emissions sources (urban, ag, industrial) are variable across the landscape
- Often ecosystems are affected by combinations of source types
- Urban emissions of N > S emissions because of on-road emissions of NO_x and NH₃
- Thus, eutrophication or N-excess effects are common near urban source areas



Database of Road Transportation Emissions (DARTE)
Metric Tons Carbon Dioxide Emitted in 2012



https://daac.ornl.gov/CMS/guides/CMS_CO2_Relationships.htm

